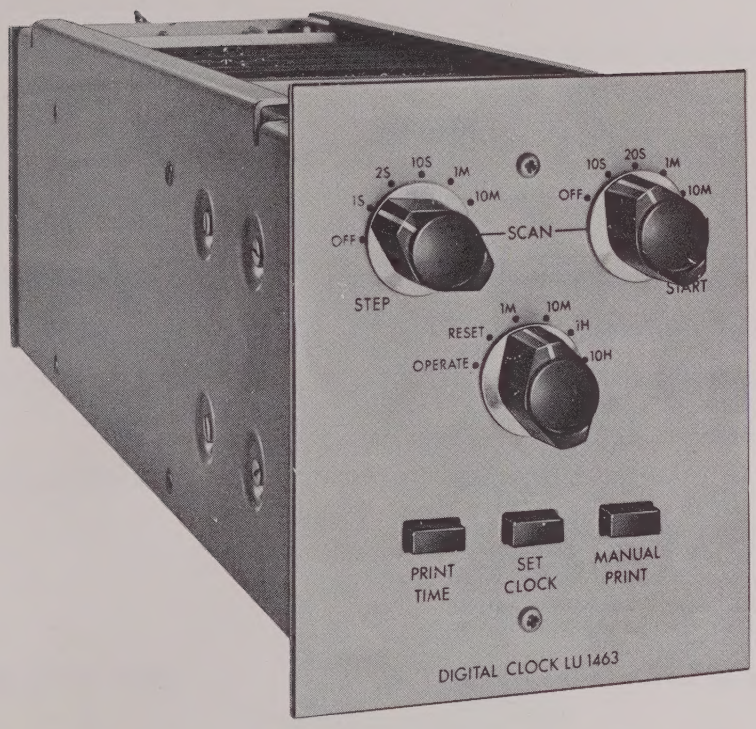
DIGITAL CLOCK
LU 1463



SEG

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MP MASTER
MA24417

SECTION 1.

INTRODUCTION

The module has been specifically designed to generate TIME information in the Compact Logger Systems LY1470 and LY1471. It may also be used in any data logging system requiring TIME in BCD form. Minute and hour signals are available for this purpose.

Second, minute and hour signals are provided to control the 'start scan' and 'step scan' functions of the system Scanner.

DAY (24 hour) pulses are available to drive a system Digital Calendar.

SECTION 2.

SPECIFICATION

BASIC TIME SOURCE	:	50 c/s mains supply.
TIME STANDARD	:	One second pulses from synchronous clock motor.
TIME OUTPUTS	:	1. BCD signals representing hours and minutes. '0' = -2V to +1V. '1' = -5V to -13V. 2. 24 hour DAY pulses, represented by '1' 's.
COMMAND OUTPUTS	:	1. "Start Scan" pulses to Scanner at 10 sec., 20 sec., 1 min., 10 min. and 1 hr. intervals. 2. "Step Scan" pulses to scanner at 1 sec., 2 sec., 10 sec., 1 min. and 10 min. intervals. Front panel switches are used to select the required intervals. The switches have OFF positions if the facilities are not required.
ZERO RESET OF TIME	:	By means of a front panel SET CLOCK push-button.
PRINT TIME	:	Operation of front panel PRINT TIME push-button causes time information to be recorded at the start of a scan.
MANUAL PRINT	:	This also gives print-out of time. It is normally used to check the time signal set into the unit.
POWER REQUIREMENTS	:	95V to 130V or 190V to 260V, 50 c/s. 11VA.
AMBIENT TEMPERATURE	:	$0^{o}C$ to $50^{o}C$.
WEIGHT	:	4 lb. 13 oz. (2 kg) approx.
DIMENSIONS (Excluding front and rear panel fixtures)	:	5.25 in. x 4.25 in. x 14 in. (13.3 cm x 10.8 cm. x 35.5 cm.)

NOTE: The unit may be driven from a 60 c/s source if required. A clock motor rated at that frequency is available to special order.

SECTION 3.

INSTALLATION

General

The module is usually supplied as part of a complete system and details of its front panel switch settings and input and output connections will be found in the preliminary sections of the system handbook.

It is also available as a separate item, the general information given below supplying the data required its use in any special set-up.

Connector Details

Plug PLA

Mains power is applied through fixed plug PLA on the rear panel of the module, the positions of the line, neutral and earth pins being shown in diagram 1. No mains on/off switch is fitted.

Mains Input Plug PLA.
Diagram 1

Socket SKTA

Output to the system recording equipment and Scanner are routed through this connector.

Table 1. Socket SKTA Details

Pin Designation	Service	Remarks
A, B, C	------	Not Used
D	Start Scan	Normally at '1'. Changes to '0' to operate system Scanner.
E		
F, H	Step Scan	
J, K, L, M	------	Not Used
N, P	Print Control	Normally at '0'. Changes to '1' to command print out.
R, S		Normally at '1'. Changes to '0' to prime time input gates of drive unit.
T, U	1 Minutes	Applied to system recording equipment.
V, W	2 Signals	
X, Y	4 1 to 10 in	
Z, a	8 BCD form	

Table 1. Socket SKTA Details - continued

Pin Designation	Service			Remarks
b c d e			------	Not Used
f h	2		Hours Signals 10 and 20	
j k	1		in BCD form	
m n	8		Hours Signals	
p r	4		1 to 10 in	Applied to System
s t	2		BCD form	recording equipment.
u v	1			
w x	4		Minutes Signals	
y z	2		10 to 60 in	
AA BB	1		BCD form	
CC DD			24 Hour Signal	To System Digital Calendar
EE FF			-	Not Used
HH			Common Rail	System Connection

Mains Selector Plug

The Mains Selector Plug (MSP1) is engraved with 115V and 230V markings and should be adjusted so that the metal pointer at the side of the module is opposite to the marking corresponding to the user's mains voltage.

Mains Fuse

Check that the mains fuse is correctly rated - 1A for 230V supplies and 2A for 115V supplies. The fuseholder is located between MSP1 and PLA.

Mounting Arrangements

The Compact Logger cabinets have been specifically designed to accommodate a number of modules of identical size, one being the Digital Clock. The modules slide into the cabinet space frame along lips on their side panels which act as runners. They are retained by a wing nut at the

rear. Interconnecting plugs are free on their loom to avoid connector alignment problems. 50 way connectors, where used, are retained by straight knurled edge screws which must be released to remove the free mating components.

A Mounting Rack, LY1472, is available for housing a maximum of four modules of Digital Clock dimensions. It is intended for use in multi-layer systems, but can be provided as a separate item.

SECTION 4.

OPERATION

Setting Up to Give a Time Reading

(1) Turn the OPERATE switch to the RESET position and depress the SET CLOCK push-button. The clock is now set to a zero time count.

(2) Turn the OPERATE switch to the 1M position and depress the SET CLOCK push-button as many times as there are units of minutes to be set into the clock.

(3) Repeat 2 with the OPERATE switch in the 10M, 1H and 10H positions to set up tens of minutes, units of hours and tens of hours respectively.

(4) Return the OPERATE switch to the RESET position.

(5) The clock is now set up. It is only necessary to move the OPERATE switch to the OPERATE position to start the clock.

(6) The time set in may be checked by punching or printing out. This is done by depressing the MANUAL PRINT push-button when the OPERATE switch is in the RESET position. If an incorrect reading is obtained the clock must be reset to zero and the setting up procedure must be repeated.

(7) The procedure outlined in 6 will usually be carried out a minute or two ahead of true time and the movement of the OPERATE switch to OPERATE (see 5) may then by synchronised with the arrival of a true time reading taken from a clock or radio time signal.

(8) Alternatively, turn the OPERATE switch to OPERATE at the commencement of any arbitrary time period.

(9) Note that the "carry" between stages is not inhibited during setting-up. Consequently, if more than nine pulses are set into a decade or if more than five pulses are set into a hexade, the next stage will include an extra "one" in its total.

Recording Time

To record time information on the output devices depress the PRINT TIME push-button to its "locked" position. Recording will then take place before the commencement of a scan.

Alternatively, when the System Scanner is controlled by the clock, as described below, time will be recorded automatically before the commencement of each scan.

Controlling System Scanning

An outstanding feature of a complete system incorporating a Scanner LU1461 or similar module is that it may be made fully automatic by driving the Scanner from the Clock. "START SCAN" command signals are generated by the clock every 10 and 20 seconds and every 1, 10 and 60 minutes; "STEP SCAN" command signals are available every 1, 2 and 10 seconds and every 1 and 10 minutes. The "START SCAN" and "STEP SCAN" signals simulate the functions controlled by the START SCAN and PRF switches on the Scanner front panel when the EXT CLOCK switch is depressed to its "locked" position. If control by the clock is not required ensure that the START

and STEP switches on the front panel of the clock are turned to their OFF positions and that the EXT CLOCK switch on the Scanner is in its "non-locked" position.

An interesting example of automatic operation of the logger would be its use in measuring the values of a group of 20 d.c. signal sources every hour on the hour (issue of "STEP SCAN" and "START SCAN" signals may be synchronised with true time) at a speed of, say, 1 channel per second. To achieve this, set the scanner MODE switch to SS, its SCAN switch to AD and its EXT CLOCK switch to the "locked" position. Set the clock START switch to 1H and its STEP switch to 1S. The logger will then start recording at the commencement of the next hour, record for 20 seconds and repeat the process each hour while the system is in operation. Any practicable settings of the START and STEP switches may, of course, be used to vary the timing of the process.

SECTION 5.

PRINCIPLES OF OPERATION

Basic Principles (Diagram 2)

A train of one second pulses, developed by a generator driven from the mains power supply, is applied to a series of divider stages which count down to seconds, minutes and hours. Print out information, Scanner start and step scan signals, and 24 hour (day) signals are made available, as shown in diagram.

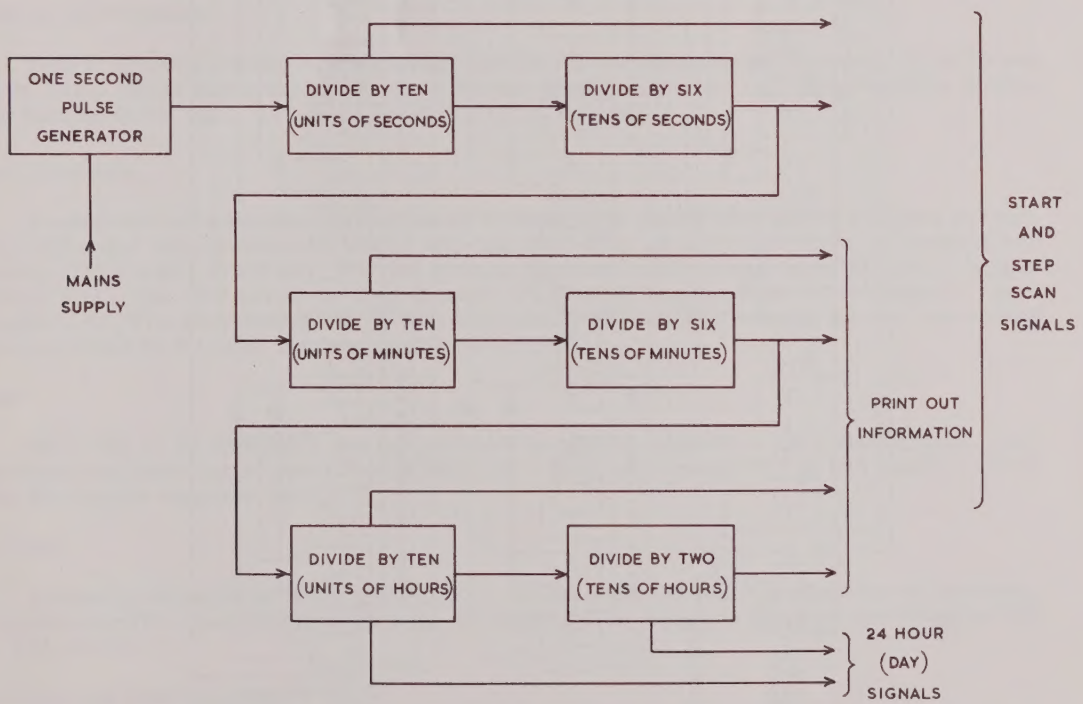

ONE SECOND PULSE GENERATOR
MAINS SUPPLY
DIVIDE BY TEN (UNITS OF SECONDS)
DIVIDE BY SIX (TENS OF SECONDS)
DIVIDE BY TEN (UNITS OF MINUTES)
DIVIDE BY SIX (TENS OF MINUTES)
DIVIDE BY TEN (UNITS OF HOURS)
DIVIDE BY TWO (TENS OF HOURS)
START AND STEP SCAN SIGNALS
PRINT OUT INFORMATION
24 HOUR (DAY) SIGNALS

Diagram 2. Block Diagram Digital Clock LU 1463.

Logic Description (Diagram 3)

Notation

In this description, the convention whereby binary '1' = -5V to -13V and binary '0' = -2V to +1V is used for BCD outputs.

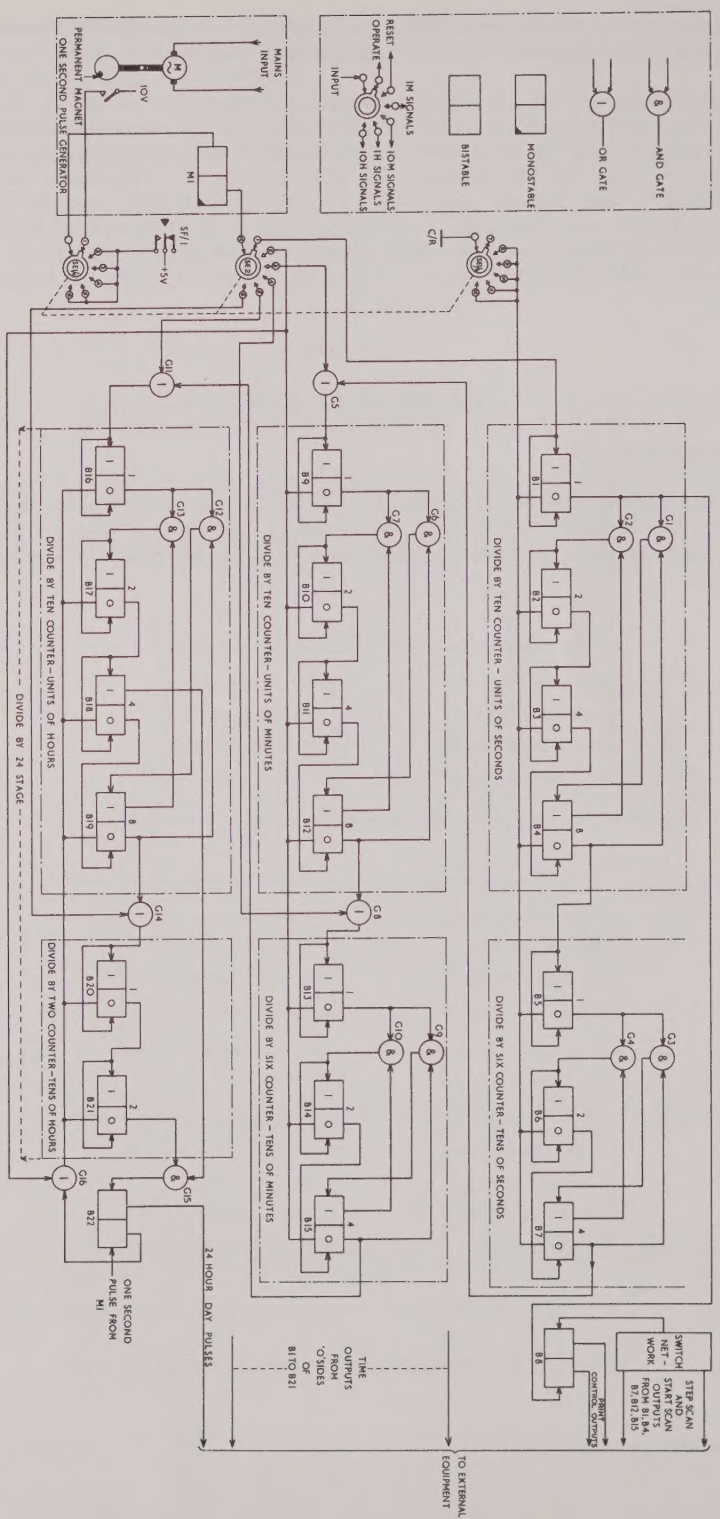


Diagram 3. Logic Diagram Digital Clock LU 1463.

One Second Pulse Generator

A synchronous clock motor rotates a disc in which a small permanent magnet is embedded. The magnet operates a read relay unit, acting as a proximity switch, once each second and contact closure is used to fire a pulse shaping monostable M1.

The output from the monostable, while SE is set to OPERATE, is fed to a series of 'divide by ten' and 'divide by six' counters which count down to seconds, minutes and hours.

Divide by Ten Counters

Three such counters are employed to provide units of seconds, minutes and hours. Each is formed by four bistable stages connected together by means of gates to give a count of ten, instead of the count of sixteen which would be available if they were connected in series.

Consider the Divide by Ten Counter - Units of seconds, shown in diagram 3. With the counter set to zero, i.e. while the '0' sides of bistables B1 to B4 give '0' output, G1 is closed by the '0' output from B4 while G2 is primed by the '1' output from B4.

Pulses fed into B1 are counted in binary form until B4 turns over as the eighth pulse is received. G2 is now closed and G1 is primed by the action of B4. The ninth input pulse does not generate a 'carry'. The tenth, however, does. This is routed through G1 to turn over B4 and issue one pulse to B5. Thus, after ten input pulses have been accepted, one output pulse is generated and all bistables are set to their zero states.

Divide by Six Counters

Tens of seconds and tens of minutes are totalled by two divide by six counters, B5 to B7 and B13 to B15. These differ from the divide by ten counters in having only three bistable stages. They function in the same manner as the divide by ten counters.

Hours Counters

To generate hours signals it is necessary to count up to twenty four before resetting to zero. Also, BCD output necessitates a divide by ten stage B16-B19, as described above, followed by two bistables B20 and B21 in series. The '24' state is detected by G15 whose output is used to trigger bistable B22. One B22 output is used to reset all bistable stages of the hours counters to zero through G16. The other output is a 24 hour day pulse. B22 itself is reset by the next one second pulse generated by M1 after hours counter reset occurs.

Reset

While SE is in its RESET position, SF may be used to establish a time count of zero. SE2 distributes the reset signal generated by M1 to B9 - B15, and through G16 to B16 - B21. SE1/b holds the seconds stages at zero.

Set Clock

A time signal may be set up by turning SE to its 1M, 10M, 1H and 10H positions successively, and depressing SF to operate M1. SE2 routes the signals to the required counters through gates G5, G8, G11 or G14.

Start Scan and Step Scan Signals

The switching network block represents an arrangement which directs second signals, minutes signals or one hour signals to the system scanner. Also, it operates a print control bistable.

Print Control Bistable

This is B8. It controls circuitry in output drive devices which selects either voltmeter or time information for recording purposes. Trigger signals are taken to it, or the MANUAL PRINT push-button is depressed, to command print out of TIME. Reset is achieved by a one second pulse.

SECTION 6

TECHNICAL DESCRIPTION

Introduction

A circuit diagram of the module is provided at the rear of this manual. It will be noted that the printed circuit boards shown on the diagram are identified by the letters A to G inclusive. Throughout this description, references to components on a printed circuit board will be followed by the letter of the board, e.g. MR16 on board B will be given as MR16 (B).

One Second Pulse Generator

Synchronous clock motor X1 rotates a disc, to which a permanent magnet is attached, at a speed of one revolution per second. The magnet operates reed relay RLA which directs positive pulses to shaping monostable VT5/VT6(B). The time constant of the monostable, approximately 120 msecs, is arranged to be greater than the contact closure time of the reed. Thus, double counting due to contact bounce is eliminated.

Divide by Ten Counters

The counters are fitted to boards C, E and G. Their circuits may be interpreted by reference to the logic diagram and description given in section 5, where, for example, B16 to B19 are equivalent to VT1-VT8(C), G12 represents MR9, MR11 and G13 represents MR13, MR15.

Divide by Six Counters

Boards D and F accommodate the two divide-by-six counters. Again, interpretation of the circuits may be made by comparison of one counter, VT1-VT6 (D), MR9, MR11 and MR13, MR15 with B13-B15, G10 and G9 on the logic diagram.

Counter Interconnections

The seconds counters on boards G and F are directly linked, i.e. pin 20 (G) is joined to pins 16 and 19 (F).

Tens of seconds are coupled to units of minutes by means of OR gates on board 3. Other counters are similarly interconnected. One input to each OR gate is the binary count to the next significant decade. The other OR input is the series of setting up pulses required to establish a selected time count (see 'Set Clock Circuitry').

Hours Counters

To obtain a 24 hour count, the divide-by-ten stage on board C is connected in series with bistables VT1, VT2 (B) and VT3, VT4 (B). The two bistables correspond with B20 and B21 on the logic diagram; MR16 (B) and MR18 (B) are represented by G15.

Reset of the hours counters takes place when the 24 hour state is detected by MR16 (B) and MR18 (b). Bistable VT7, VT8 (D) turns over and issues a positive reset pulse through MR14 (B1). At this instant, i.e. 00.00.00 hours, a positive DAY pulse is issued by VT7 (D). The next one second pulse from monostable VT5, VT6 (B) resets VT7, VT8 (D).

Time Outputs

Time signals to external equipment are routed through SKTA. They are derived from the '0' sides of the minutes and hours bistables, identified by socket pin references on the circuit diagram.

Print Control

Bistable VT 7, VT8(F) is used to prime time input gates and inhibit voltmeter input gates in output drive devices when time is to be recorded. It corresponds with B8 on the logic diagram and is operated by either the MANUAL PRINT push-button SD or by start scan pulses from SB, directed through SC/1 to pin 4 (F). While the bistable commands TIME print out and SC is in its locked

state driving the system scanner, the '1' output from VT7 inhibits the scanner. The bistable is reset by the one second clock pulse.

Start Scan and Step Scan Signals

Switches SA and SB may be set in accordance with the front panel notation on the circuit diagram, to issue step scan and start scan signals to the system scanner through pins F, H and D, E, SKTA. As described previously, start scan signals may be cut off by depression of SC.

Set Clock Circuitry

A time signal is set up by turning SE, shown in the OPERATE position, (i) to RESET and depressing SF to achieve a zero time count and (ii) to its various other positions to apply pulses, by depressing SF, to the required minutes and hours counter stages.

Power Supplies

A mains transformer T1, with two 0V to 115V primary windings, is used. They may be connected in series for 230V working or in parallel for 115V working.

A 16V secondary is rectified, smoothed and fed through a series regulator to provide a -10V supply. The same secondary is rectified, smoothed and fed via a shunt regulator to provide a +10V bias supply.

SECTION 7

TEST PROCEDURE

Introduction

The procedure given in this section is basically the production test to which all units are subjected prior to despatch. It is provided to enable the user to confirm the performance of the unit and to make any necessary adjustments.
Equipment:

(a) Multi-Range Test Meter, 20000Ω/V.

(b) Double-Beam Oscilloscope - Solartron CD1012.3 or similar.

(c) Low Frequency Pulse Generator.

(d) It is assumed that the module is incorporated in a Compact Logger System.

Access

Release the free connectors and remove the wing nut at the rear of the module. Ease the module out of its cabinet and position it on the bench in such a way that the free connectors which were attached to it may be re-attached through extension leads. A 50-way plug and a 50-way socket, compatible with the free and fixed connectors and linked together by insulated leads about 3ft. long in a 'one-to-one' pin arrangement, will be suitable for signal coupling. A three-lead cable with suitable connectors will be required for the power supply.

Release the two holding screws on the right-hand side panel of the module (viewed from the front) and lower the panel. The printed circuit boards may now be hinged out for servicing.

Initial Checks

(a) Ensure that the mains selector plug is set to the correct voltage tapping. Connect the unit to the mains supply.
(b) Check that the clock motor is running.
(c) On board A (PCB14639001), check the following:
  (i) -22V (±10%) between pin 4 and common rail.
  (ii) +10V between pin 9 and pin 10. Adjust RV1, if necessary.
  (iii) -10V between pin 11 and pin 10. Adjust RV2, if necessary.
  (iv) +5V between pin 1 and pin 10.

(a) Set the OPERATE switch to RESET and depress the SET CLOCK push-button. Depress the MANUAL PRINT push-button. A zero time reading should be recorded by the output equipment (printer, typewriter or punch).
(b) Turn the OPERATE switch to OPERATE. With the oscilloscope, check that a one second pulse appears at pin 5 (B). The pulse should be positive going and of approximately 60msec. duration.
(c) Connect the oscilloscope to pin 4 (B). Check that a pulse of approximately 120msec. duration appears once each second.
(d) Remove the lead connected to pin 4 (B). Connect the pulse generator to the free lead. Connect one beam of the oscilloscope to 16 (G) and the other beam to pin 20 (G). Trigger from pin 20. Check that the output (pin 20) is equal to the input (pin 16) divided by ten.
(e) Transfer the oscilloscope leads to input pin 16 (F) and output pin 22 (F). Check that the output is equal to the input divided by six.
(f) Repeat (d) on board E.
(g) Repeat (e) on board D.
(h) Repeat (d) on board C.
(j) Connect the oscilloscope leads to input pin 16 (C) and output pin 21 (D). Check that the output is equal to the input divided by 24.
(k) Monitor pin 21 (F). The bistable should change state when the MANUAL PRINT (SD), push-button is depressed. It should reset within two seconds when the button is released.
(l) Check that an output pulse appears at pins F and H, SKTA at the correct time division intervals for all positions of the STEP SCAN (SA) switch.
(m) Repeat (l) for the START SCAN (SB) switch, checking pins D and E.
(n) Disconnect the pulse generator and reconnect the free lead to pin 4 (B).
(p) Using the procedure given in paragraphs 1 to 6 of 'Setting Up to give a Time Reading' in the section headed OPERATION, confirm that complete print out sequences from 0 to 9 can be carried out for units of minutes and hours, 0 to 5 for tens of minutes and 0 to 2 for tens of hours.

Note: 1. The use of a pulse generator enables testing to be carried out in a relatively short period. The frequency of the generator may be set to a maximum of 1k c/s.

2. A BCD to decimal read out device, with digital display can, if available, be substituted for a system output device.

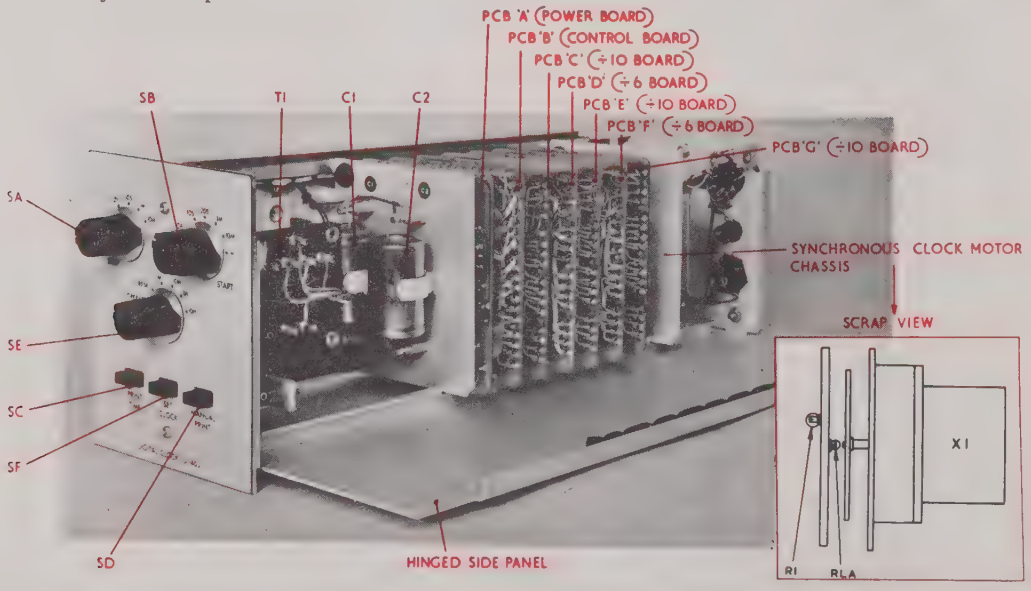


Diagram 4. Component location, Main Unit.

COMPONENTS LIST

for

DIGITAL CLOCK LU1463

MAIN UNIT

PRINTED CIRCUIT BOARDS

Description	Solartron Part No.
Power Board	1463 9001
Control Board	1463 9004
Binary Board - 10	1463 9002
Binary Board - 6	1463 9003

RESISTORS

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon

CAPACITORS

Circuit Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufacturer & Type	
C1	1000	-20 +100	25	2607 91000	Hunts	MEF 109 AT
C2	1000	-20 +100	25	2607 91000	Hunts	MEF 109 AT

MISCELLANEOUS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
PLA	Plug 3-way	3523 03030	Bulgin	P429
SKTA	Socket 50-way	3529 50080	Amphenol	M
RLA	Relay	3007 60010	Flight Refuelling	MRG-1-30AT
T1	Transformer	3010 50260		
FS1	Fuse 1 A	3601 01300	Belling & Lee	L562/1
MSP1	Mains Supply Panel	3990 00060	McMurdo	BMVS/A/4/02
X1	Motor, 115V	3802 10130	Smiths	400
SA	Switch, Wafer	3731 06030		
SB	Switch, Wafer	3631 06030		
SC	Switch, Push Button	3770 00090	Plessey	P5
SD	Switch, Push Button	3732 00080	Plessey	P5
SE	Switch, Wafer	3723 06010		
SF	Switch, Push Button	3770 00080	Plessey	P5

COMPONENTS LIST

for

PRINTED CIRCUIT BOARD B 1463 9001

POWER BOARD (CLOCK)

RESISTORS

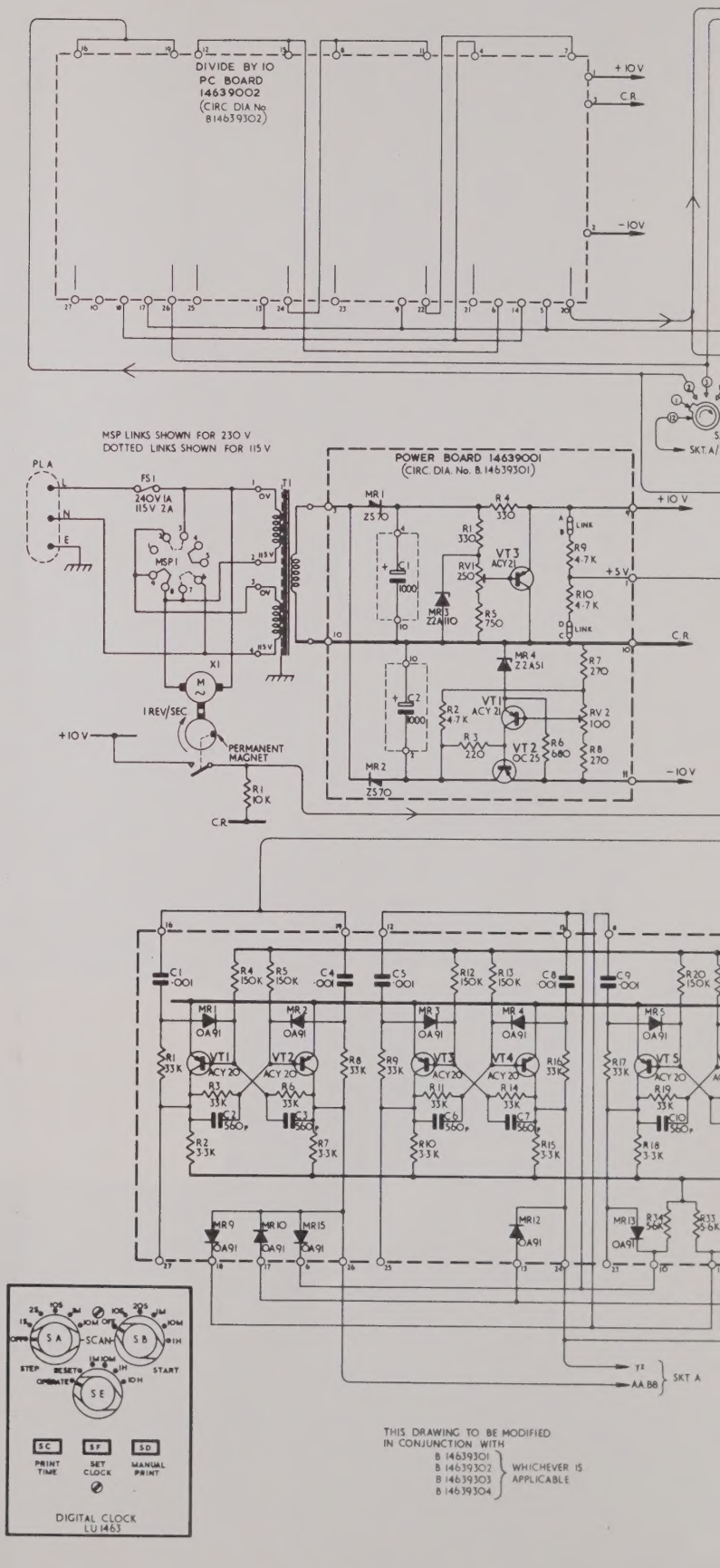
Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	330	5	2.6	1734 23300	Painton	MV1A
R2	4.7k	10	$\frac{1}{4}$	1723 34700	Dubilier	BTT Carbon
R3	220	10	$\frac{1}{4}$	1723 22200	Dubilier	BTT Carbon
R4	560	5	2.6	1734 25600	Painton	MV1A
R5	750	10	$\frac{1}{4}$	1723 27500	Dubilier	BTT Carbon
R6	680	10	$\frac{1}{4}$	1723 26800	Dubilier	BTT Carbon
R7	270	10	$\frac{1}{4}$	1723 22700	Dubilier	BTT Carbon
R8	270	10	$\frac{1}{4}$	1723 22700	Dubilier	BTT Carbon
R9	4.7k	10	$\frac{1}{4}$	1723 34700	Dubilier	BTT Carbon
R10	4.7k	10	$\frac{1}{4}$	1723 34700	Dubilier	BTT Carbon

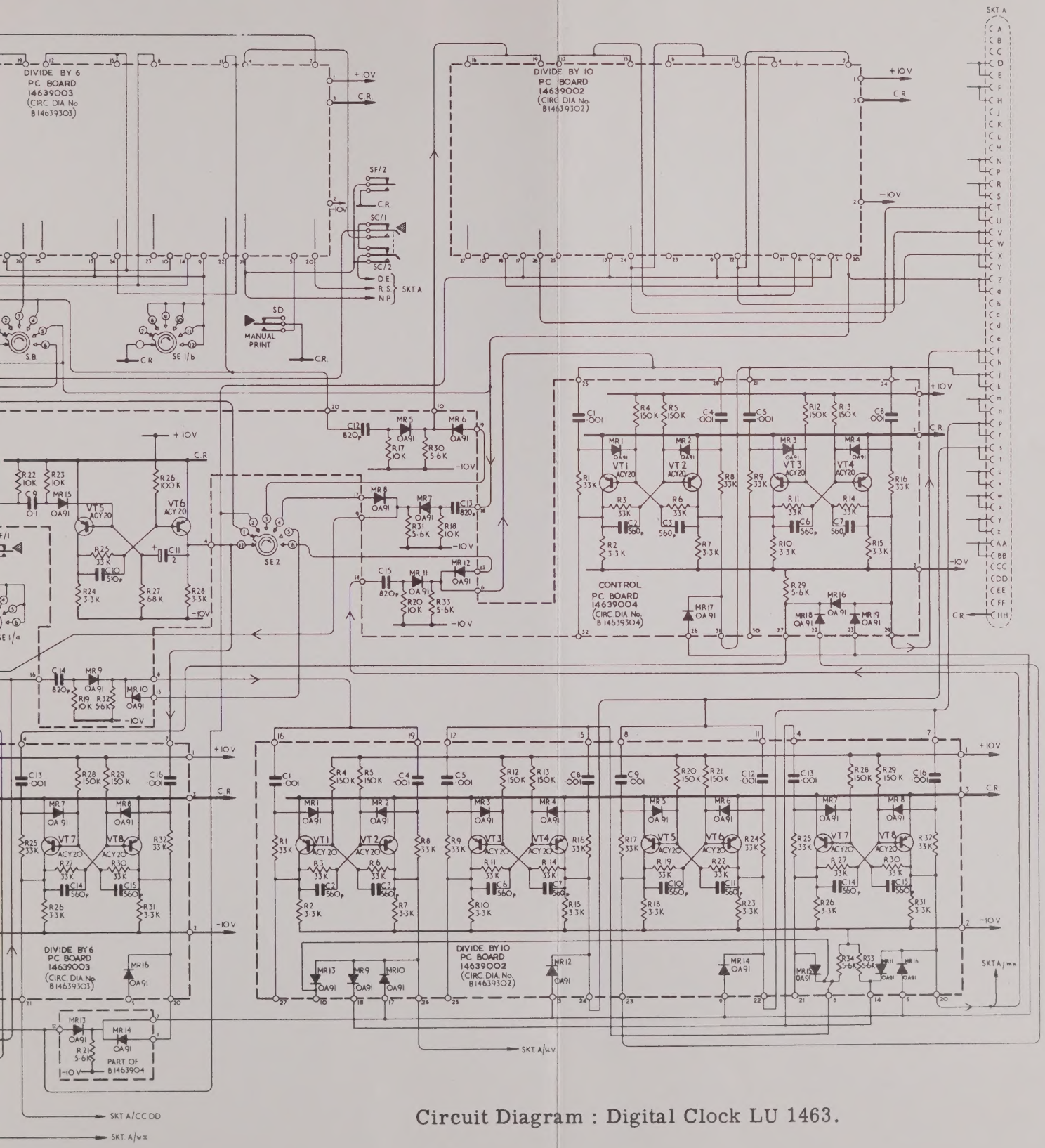
RESISTORS, VARIABLE

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
RV1	250	20	$\frac{1}{2}$	1100 31210	Welwyn	P25M
RV2	100	20	$\frac{1}{2}$	1100 31180	Welwyn	P25M

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 21110	Ferranti	ZS70
MR2	Diode	3005 21110	Ferranti	ZS70
MR3	Diode, Zener	3005 21580	S.T.C.	Z2A110F
MR4	Diode, Zener	3005 21490	S.T.C.	Z2A51F
VT1	Transistor	3005 50490	Mullard	ACY21
VT2	Transistor	3005 50990	Mullard	OC25
VT3	Transistor	3005 50490	Mullard	ACY21


DIVIDE BY 10
P.C. BOARD
14639002
(CIRC. DIA No
B14639302)
+10V
C.R
-10V
MSP LINKS SHOWN FOR 230 V
DOTTED LINKS SHOWN FOR 115 V
PLA
FS1
240V 1A
115V 2A
T1
MSP1
X1
1 REV/SEC
PERMANENT
MAGNET
POWER BOARD 14639001
(CIRC. DIA. No. B.14639301)
MR1
2S70
MR2
2S70
MR3
2S70
MR4
2.2A51
R4
330
R1
330
VT3
ACY21
RV1
250
R5
750
MR13
Z2A110
R9
4.7K
R10
4.7K
LINK
+5V
R7
270
VT1
ACY21
R2
4.7K
RV2
100
R3
220
VT2
OC25
R6
680
R8
270
C1
1000
C2
1000
R1
10K
C1
.001
R4
150K
R5
150K
C4
.001
C5
.001
R12
150K
R13
150K
C8
.001
C9
.001
R20
150K
MR1
OA91
MR2
OA91
MR3
OA91
MR4
OA91
MR5
OA91
VT1
ACY20
VT2
ACY20
VT3
ACY20
VT4
ACY20
VT5
ACY20
R1
33K
R8
33K
R9
33K
R16
33K
R17
33K
R3
33K
R6
33K
R11
33K
R14
33K
R19
33K
C2
560P
C3
560P
C6
560P
C7
560P
C10
560P
R2
3.3K
R7
3.3K
R10
3.3K
R15
3.3K
R18
3.3K
MR9
OA91
MR10
OA91
MR15
OA91
MR12
OA91
MR13
OA91
R34
56K
R33
5.6K
Y2
AA BB
SKT A
SA
SCAN
SB
SE
STEP
RESET
START
OPERATE
SC
PRINT
TIME
SF
SET
CLOCK
SD
MANUAL
PRINT
DIGITAL CLOCK
LU1463
THIS DRAWING TO BE MODIFIED
IN CONJUNCTION WITH
B 14639301
B 14639302
B 14639303
B 14639304
WHICHEVER IS
APPLICABLE



Circuit Diagram : Digital Clock LU 1463.

MP MASTER
MA24417